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OFFICIAL NEWSLETTER OF THE INTEGRATED PEST MANAGEMENT RESEARCH, DEVELOPMENT AND APPLICATIONS PROGRAM
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IPM Research Highlights

This special edition (#3) of the newsletter provides a timely introduction and description of new technology. The information is concerned with southern pine beetle hazard rating and trend prediction, and an economic evaluation for using borax to prevent annosus infection. We encourage users to distribute some or all of this information to associates, clients, or cooperators through their own newsletters, training sessions, fact sheets, technology tips, and to contact the appropriate individual indentified with each technique if there are questions or problems.

If you use this information in any way, the Program would appreciate knowing how it was used, whether it met user needs in a realistic way, and wheter users have suggestions for improving the techniques that might be passed on to the developers.

TFS GRID HAZARD

Purpose:

To rate relative susceptibility of Texas Forest Service grid blocks to SPB infestation.

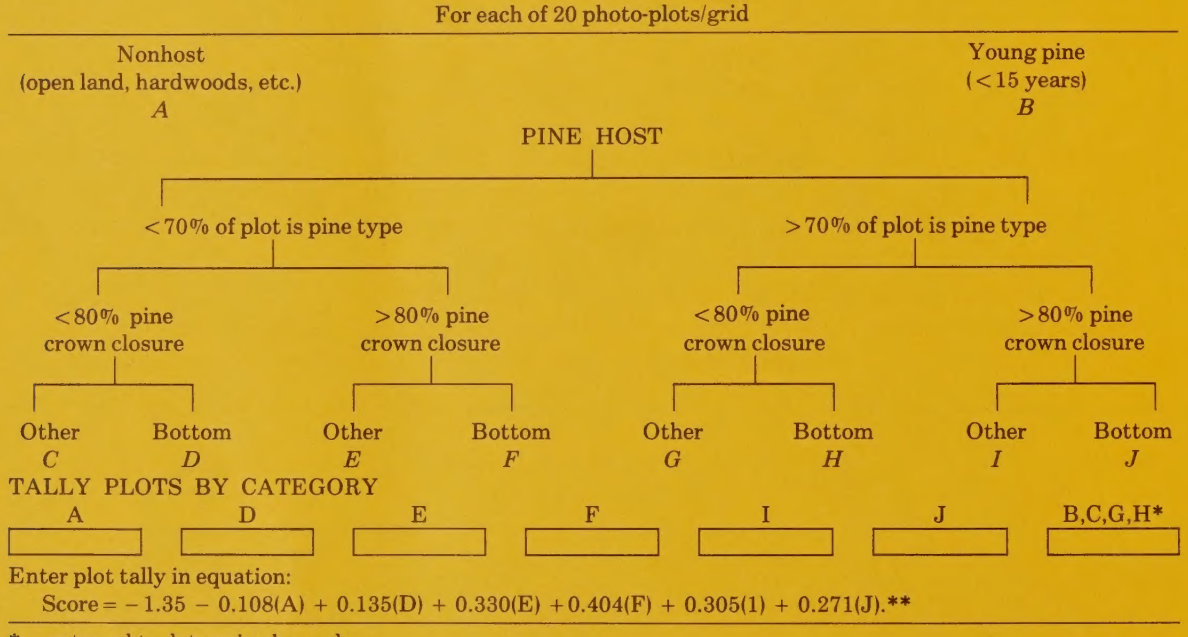
Description:

TFS GRID HAZARD is a large area hazard-rating system designed to rate Texas Forest Service grid blocks (18,000-acre units) as high, moderate, or low hazard based on site and stand conditions likely to support outbreak populations of SPB. The system was developed and validated in east Texas using historical beetle infestation records. It is easily applied and uses broad data categories for input. Although specifically designed for east Texas, the technique is easily adaptable to other areas in the Gulf Coastal States.

Inputs:

Information on host type, percent pine, stand density, and landform position from each of 20 uniformly distributed, circular, 30-acre photo plots per grid block. Photo samples may be interpreted from 1:60,000 to 1:120,000 scale color infrared photography. The site/stand factors and classification considered are:

1. Presence of host type (nonhost type, or if pine, whether it is < > 15 years of age)
2. Percentage of pine (< or > 70 percent of stand pine type)
3. Percentage crown closure (< or > 80 percent)
4. Landform classification (bottomland or other terrain)



* not used to determine hazard.

** Values for input variables (A-J) are the numbers of photo plots in each of the combinations of site/stand conditions (only values for A, D, E, F, I, and J are utilized in the equation.)

Outputs:

A numerical score where:

Score	*Hazard class*
> 1.1	High
0.4 to 1.1	Moderate
< 0.4	Low

General Reference:

Billings, R. L.; Bryant, C. M., V. Developing a system for mapping the abundance and distribution of SPB habitats in east Texas. *In:* Proceedings, Symposium on Insect and Host Tree Interactions. 1983 March 29 – 31; Frieburg, West Germany. Zeit. angew. Entomol. 96(2):208 – 216; 1983.

EXCHANGE Book
SEP 28 1984

Additional Information: Questions regarding this model and its use may be addressed to: Dr. Ronald F. Billings, Texas Forest Service, Pest Control Section, P. O. Box 310, Lufkin, TX 75901, Tele: 409/632-7761.

AR HAZARD

Purpose: To estimate relative susceptibility of Arkansas pine stands to SPB attack.

Description: AR HAZARD is a hazard-rating system based upon analysis of tree, site, and stand characteristics of pine stands in southern Arkansas. The system is easily applied and uses readily obtained inventory data.

Inputs:

1. Total stand basal area (ft^2/ac.).
2. Hardwood basal area (ft^2/ac.).
3. Stand age (years).
4. Radial growth in last 10 years (inches to nearest tenth).

Outputs: Numerical hazard-rating score.

Accessibility: Hazard estimates may be developed by entering the above INPUT data into the following equation:

HAZARD SCORE = 64.3 (radial growth) + 3.3 (stand age) + .93 (hardwood BA/A) − 1.5 (total BA/A)

Stand susceptibility can then be determined as follows:

Score	*Hazard Class*
>101	Low
1 – 100	Moderate
<1	High

AR HAZARD may be used as described above or is available in a computerized format via interactive phone connection or by sending a blank diskette to: Robert J. Uhler, Computer Specialist, USDA Forest Service, Forest Pest Management, Doraville, GA 30340, Tele: 404/881-2986. The return diskette will also include Mississippi Hazard B, Arkansas Hazard, Piedmont Risk, and Mountain Risk.

General Reference: Ku, T. T.; Sweeney, J. M.; Shelburne, V. B. Hazard rating of stands for southern pine beetle attack in Arkansas. *In:* Hedden, R. L.; Barras, S. J.; Coster, J. E., coords. Hazard Rating Systems in Forest Insect Pest Management: Symposium Proceedings; 1980 July; Athens, GA. Gen. Tech. Rep. WO-27. Washington, DC: U.S. Department of Agriculture, Forest Service; 1981. p. 145 – 148.

Additional Information: Questions regarding this model and its use may be addressed to: Staff Entomologist, USDA Forest Service, Forest Pest Management, 1720 Peachtree Rd., NW, Atlanta, GA 30367, Tele: 404/881-2961.

TX HAZARD

Purpose: To rate relative susceptibility of pine stands to SPB attack and timber loss.

Description: TX HAZARD is a method of rating stand condition classes for susceptibility to SPB attack and ultimate potential for timber loss. The model was developed for mixed and pure pine forests in east Texas using data collected from 1100 plots dur-

ing a period of moderately high beetle activity from 1973 – 1975. The model was tested on an additional 182,000 acres in east Texas and 177,000 acres in Louisiana using aerial photo hazard ratings and historical infestation records. The model is also considered applicable in similar Coastal Plain areas of Texas, Louisiana, Mississippi, and Alabama.

Inputs:

Required:
1. Basal area/acre
2. Average stand height or dbh
3. Landform (bottom, ridge, other)

Landform is considered more as an indicator of moisture regime than true topographical position; i.e., bottom = moist, low-lying pine sites; ridge = drier upland sites, and other = intermediate conditions.

Optional: Number of acres in each hazard class by stand or ownership.

Outputs:

Normal: SPB hazard is determined by basal area/acre, tree height or dbh, and landform class (table 1).

Table 1.

	Ridge			Other terrain			Bottom		
	tree height (feet)								
Pine basal area (sq ft/acre)	<50	50 – 75	>75	<50	50 – 75	>75	<50	50 – 75	>75
	hazard								
<80	low	low	low	low	low	low	low	low	med
80 – 120	low	low	med	low	med	med	med	med	high
>120	low	med	med	med	high	high	med	high	high
	<6	6 – 12	>12	<6	6 – 12	>12	<6	6 – 12	>12
	tree diameter (inches)								

Optional: A 5-year loss projection by hazard class; i.e., number of spots and trees expected to be killed during a 5-year period within a given number of acres of a specific hazard type (table 2).

Table 2.

Hazard class	Acres									
	100		300		500		700		1000	
	Spots	Trees*	Spots	Trees	Spots	Trees	Spots	Trees	Spots	Trees
High	2	140	5	420	8	700	11	980	16	1400
Moderate	1	14	2	42	4	70	5	98	7	135
Low	.2	4	.5	12	1	20	1.5	28	2	40

* Estimated trees containing living beetles at time of control, not total number of trees killed.

Accessibility:

Apply above tables or use a circular slide rule *(TEXAS SPB RATING GUIDE)* available from: School of Forestry, Stephen F. Austin State Univ., Nacogdoches, TX 75962, Tele: 409/567-3301, or

Texas Forest Service, Forest Pest Control Section, P. O. Box 310, Lufkin, TX 75901, Tele: 409/632-7761.

Interactive computer versions, excluding the 5-year loss projection, are available by accessing Apple® computers at: USDA Forest Service, Forest Pest Management, 2500 Shreveport Highway, Pineville, LA 71360, Tele: 318/473-7283, or

Texas Forest Service, Forest Pest Control Section, P. O. Box 310, Lufkin, TX 75901, Tele: 713/632-7761.

or sending a blank diskette to the Pineville address. The returned diskette will include this technique along with Mississippi Hazard B, Arkansas Hazard, Piedmont Risk, and Mountain Risk.

Additional Information: Questions regarding this model and its use may be addressed to: Garland N. Mason, Research Coordinator, USDA Forest Service, Integrated Pest Management Program, 2500 Shreveport Highway, Pineville, LA 71360, Tele: 318/473-7250.

General Reference:

Mason, G. N.; Hicks, R. R., Jr.; Bryant, C. M., V; Mathews, M. L.; Kulhavy, D. L.; Howard, J. E. Rating southern pine beetle hazard by aerial photography. *In:* Hedden, R. L.; Barras, S. J.; Coster, J. E., eds. Proc. Symp. on Hazard Rating Systems in Forest Insect Pest Management. Gen. Tech. Rep. WO-27. Washington, DC: U.S. Department of Agriculture, Forest Service; 1981. 109 – 114.

MOUNTAIN RISK

Purpose: To evaluate forest stands in the southern Appalachian mountains for susceptibility to SPB infestation.

Inputs:

1. Proportion of pine in the stand (shortleaf, pitch, or Virginia pine)
2. Radial growth in the last 5 years (inches)

Outputs: Risk to SPB attack

Accessibility: $RS = -1.980 - 3.97\ PPS + 2.14\ RG$

where
RS = risk score
PPS = proportion of pine (shortleaf, pitch or Virginia)
RG = ln (radial growth in the last 5 years in inches $\times$ 25.4)

RS value	*Susceptibility to SPB attack*
>0.40	low
.40 to −.56	medium
< −.56	high

Table 1.—*Risk values for shortleaf, pitch or Virginia pine in the southern Appalachian mountains*

Pine stocking	Radial growth in the last 5 years (inches)			
(%)	0.2	0.4	0.6	0.8
20	low	low	low	low
40	med	low	low	low
60	high	low	low	low
80	high	med	low	low
100	high	high	med	low

A computerized program for an Apple II is available. Send a blank diskette to USDA Forest Service, Forest Pest Management, 2500 Shreveport Highway, Pineville, LA 71360 for a copy. Mississippi Hazard B, Piedmont Hazard, Arkansas Hazard, and Texas Hazard will also be provided.

Additional Information: Questions regarding this model and its use may be addressed to: Dr. R. L. Hedden, Associate Professor, Department of Forestry, Clemson University, Clemson, SC 29631, Tele: 803/656-3302.

AERIAL GA

Purpose: To predict the number of SPB spots per acre in a given year for the Georgia Piedmont.

Description: AERIAL GA was developed from historical records from the Piedmont region of Georgia. The model predicts the total number of spots per acre of host type to be expected at the end of a given year based on an aerial survey of the same area early in that year.

Inputs:

1. Number of SPB spots/acre detected in early season flights (April – May)
2. Number of acres of susceptible host type

Outputs:

1. Predicted total yearly spots/acre in the Georgia Piedmont
2. Confidence intervals for the predicted values (Apple version only)
3. Total yearly spots detected in other areas

Accessibility:

1. Yearly spots/acre = $.691 (\text{early spots/acre})^{.7767}$
2. An Apple II computer program is also available.

Additional Information: Questions regarding this model and its use may be addressed to: Dr. R. L. Hedden, Associate Professor, Department of Forestry, Clemson University, Clemson, SC 29631, Tele: 803/656-3303.

SOUTHEAST SURVEIL

Purpose: To project the percentage of the southeastern US which has SPB activity in the current year.

Description: The equations project the percentage of land coverage over the southern pine range that currently contains SPB infestations, based upon SPB infestation coverage in a selected subsample of the region. (Infestation coverage is considered county units which contain one or more multiple-tree SPB infestations). All the models have been fitted to information in the Price and Doggett publication entitled "A History of Southern Pine Beetle Outbreaks in the Southeastern United States" (Georgia Forestry Comm. 1978. 31 p.)

Inputs: Percentage SPB coverage (PCOV) of selected subareas in the current year.

Outputs: Percentage SPB coverage (PCOV) of the Southeast in the current year.

Accessibility: Two equations are available for projecting southeastern PCOV; both include PCOV of Subarea VIII (western NC, SC, northern GA, and eastern TN). Precision of the estimate is improved somewhat by the inclusion of PCOV from subarea IX (eastern NC) and using the second equation.

1. PCOV = (40.2 + 8.6 (PCOV of subarea VII))/24
2. PCOV = (44.3 + 7.4 (PCOV of subarea VII) + 2.6 (PCOV of subarea IX))/24

Additional Information: Questions regarding this model and its use may be addressed to: Dr. William Mawby, Consultant, c/o Department of Entomology, North Carolina State University, Raleigh, NC 27607, Tele: 919/737-3804.

SOUTHEAST PREDICT

Purpose: To predict the SPB infestation coverage over the Southeast for the next year.

Description: These equations predict the percentage of land infested by SPB over the Southeast for the next year based upon the percent of the land infested in the current year in a selected subsample of the area. (Infestation coverage is considered county units which contain one or more multiple-tree SPB infestations). All the models have been fitted to data in the Price and Doggett publication entitled "A History of Southern Pine Beetle Outbreaks in the Southeastern United States" (Georgia Forestry Comm. 1978. 31 p.) The models are currently being field tested.

Inputs: Percentage SPB coverage of selected subareas in the current year (PCOVOLD).

Outputs: Percentage SPB coverage of the Southeast in the next year (PCOVNEW).

Accessibility: Four equations are available for predicting infestation coverage over the Southeast for the next year. The variety of equations offers alternate selections of input subareas which may best be suited to the user's geographic area. Equations 2 and 3, which require input from two or more subareas, should provide slightly better estimates than equation 1, using input from subarea VII only.

1. PCOVNEW = (84.6 + 7.6 (PCOVOLD of subarea VII))/24
2. PCOVNEW = (92.4 + 11.9 (PCOVNEW of subarea VII) − 15.8 (PCOVOLD of subarea VI) − 4.5 (PCOVOLD of subarea XXII))/24
3. PCOVNEW = (126.2 + 3.4 (PCOVOLD of subarea IV) + 9.3 (PCOVOLD of subarea XVIII))/24
4. PCOVNEW = (226.7 + 5.0 (PCOVOLD of subarea IV) + 6.9 (PCOVOLD of subarea VI) + 7.2 (PCOVOLD of subarea XVIII))/24

Additional Information: Questions regarding this model and its use may be addressed to: Dr. William Mawby, Consultant, c/o Department of Entomology, North Carolina State University, Raleigh, NC 27607, Tele: 919/737-3804.

SPB CONTROL PRIORITY

Purpose: To determine which SPB spots should be controlled first.

Description: This technique developed by the Texas Forest Service allows a forester to easily establish control priorities. This approach summarizes those evaluations made between 1975 and 1978, some 80 spots in east Texas. It is a qualitative approach that uses input information commonly collected by field foresters/technicians.

Inputs:

1. Number of trees with SPB brood (see table 1)
2. Number of fresh attacks (see table 1)
3. Pine basal area
4. Average tree size

Table 1.—*Symptoms associated with various stages of SPB-attacked trees*

Symptom	Fresh attacks	Developing broods	Vacated trees
Foliage	Green	Green trees with larvae; fade to yellow before brood emerges	Red, needles falling
Pitch tubes	Soft white, light pink	White, hardened	Hard, yellow, crumble easily
Checkered beetles	Adults crawling on bark	Pink or red larvae about ½ in long in. SPB galleries	Larvae and pupae are purple; occur in pockets in the outer bark
Bark	Tight, hard to remove	Loose, peels easily	Very loose, easily removed
Color of wood surface	White, except close to new adult galleries	Light brown with blue or black sections	Dark brown to black
Exit holes	-------	Few, associated with attacking adult reemergence	Numerous
Ambrosia beetle dust	-------	White, localized areas around base of trees	Abundant at base of trees

Outputs:

Table 2.—*Guide to southern pine beetle spot growth and control priorities (May through October)*

Key to spot growth	Your spot's classification	Risk-rating points
A. Stage 1 trees	absent	0
	present	30
B. Stage 1 and 2 trees	1 – 10	0
	11 – 20	10
	21 – 50	20
	more than 50	40
C. Pine basal area (ft^2/acre) (or stand density) at active head or heads	less than 80 (low density)	0
	80 – 120 (medium density)	10
	more than 120 (high density)	20
D. Stand class by average dbh (in inches)	pulpwood (9 in or less)	0
	sawtimber (more than 9 in)	10
	Total[1]	

[1] If total is 70 – 100, control priority equals High. If total is 40 – 60, control priority equals Medium. If total is 0 – 30, control priority equals Low.

General Reference:

Billings, R. F.; Pace, H. A. A field guide for ground checking southern pine beetle spots. Agric. Handbk. 558 (revised). Washington, DC: U.S. Department of Agriculture, Forest Service; 1983. 19 p.

Additional Information:

Questions regarding this technique and its use may be addressed to: Dr. Ronald F. Billings, Principal Entomologist, Texas Forest Service, Pest Control Section, P. O. Box 310, Lufkin, TX 75901, Tele: 409/632-7761.

E/A RATIO

Purpose:

To predict the relative increase in number of beetle-infested trees on a spot-by-spot basis for 3 to 6 months.

Description: The E/A (emergence:attack) ratio is designed to detect changes in infestation levels from one status to another (epidemic to endemic) and to estimate the potential for future timber loss. The model was developed and tested in natural mixed stands in four States in the Piedmont and one in the Coastal Plain. Testing was done during both epidemic and endemic population periods.

Inputs:

Required:

1. Data are collected on 2 – 4 vacated trees toward the leading edge of the infestation (immediately adjacent to currently infested trees).
2. One bark sample 3 × 3 dm is collected from each tree at the 2-m height on the bole.
3. Number of parent entries (attacks) and number of emerged beetles per sample are determined.
4. Basal area is determined with a 10-factor prism ca. 6 m in front of the leading edge of the infestation.

Optional: Sampling of four trees per spot at both the 2- and 4-m levels.

Outputs:

Normal: Categorical—the risk of increased spot growth determined by the E/A ratio, plus basal area for the moderate category:

	Low	Moderate	High
	Gradual Decline	Approaching Replacement of Currently Infested Trees	Increasing
	(Less than 0.5 × currently infested trees)	(0.5 – 1.5 × currently infested trees)	(Greater than 1.5 × currently infested trees)
E/A Ratio	<5:1	5:1 – 10:1	>10:1

low mod.	mod.	high mod.
(Basal Area (ft^2/acre)		
<90	90 – 130	>130

Optional: Continuous—based upon the E/A ratio alone

$N = a + bQ$

N = predicted value of N (number of trees infested between June and October in a given year)

$a = -3.81$

$b = 1.54$

Q = E:A ratio

General Reference: Moore, G. E.; Hertel, G. D.; Bhattacharyya, H. Emergence:attack ratio as a predictor of southern pine beetle-caused tree mortality. *In:* Modeling Southern Pine Beetle Populations. Tech. Bull. No. 1630. Washington, DC: U.S. Department of Agriculture, Forest Service; 1980. p. 169 – 171.

Additional Information: Questions regarding this model and its use may be addressed to: Kenneth M. Swain, Staff Entomologist, USDA Forest Service, Forest Pest Management, 1720 Peachtree Rd., NW, Atlanta, GA 30367, Tele: 404/881-2986.

SPBEEP

Purpose: To analyze the economic benefits and costs associated with SPB control projects.

Description: SPBEEP (southern pine beetle economic evaluation procedure) provides an economic analysis of the incremental benefits that will accrue to a decisionmaker who decides to suppress a southern pine beetle infestation by using a salvage cut. The

incremental benefits are the salvage revenues available at salvage for harvesting a percentage of the infested timber (over what would be harvested without a project), and the incremental revenues available at harvest due to the beetle not spreading into adjacent timber at present, causing an increase in mortality. These benefits are compared to project costs. Various performance measures are used to assess the project's desirability given the decisionmaker's required rate of return. Certain volume information is needed for input to the program. This information may be generated by hand (with the accompanying worksheets) or by computer using the Pre-Benefit/Cost analysis model on the same menu as SPBEEP.

Inputs:

1. Management objectives
2. Cost of the project
3. Green and salvage pulpwood prices
4. Green and salvage sawtimber prices
5. Discount rate
6. Real rate of stumpage price change
7. Forest type
8. Average site index
9. Number of age categories and the average age for each
10. Percentage of volume killed that will be salvaged with and without a project
11. Estimated volume killed for each age category, stratified by spot size class
12. Age at which stumpage will be harvested
13. Percentage of stumpage removed at thinning

Outputs:

1. Volume lost
2. Volume threatened
3. Volume at harvest
4. Stumpage growth rate
5. Spot growth rate
6. Value at harvest
7. Present stumpage values
8. Value lost
9. Value of project benefits
10. Net present value of stumpage
11. Benefit-cost ratio
12. Internal rate of return
13. Composite rate of return
14. Volume removed
15. Volume protected

Accessibility: SPBEEP is accessible via telephone and an interactive terminal with the U.S. Forest Service's Forest Pest Management computer. Dial 404/221-5200 commercial or 242-5200 FTS. The program is listed as Benefit/Cost with and without a project.

Additional Information: Questions regarding this model and its use may be addressed to: Clair H. Redmond, Economist, or Kenneth M. Swain, Staff Entomologist, USDA Forest Service, Forest Pest Management, 1720 Peachtree Rd., NW, Atlanta, GA 30367, Tele: 404/881-2961 or 404/881-2989.

IPM DECISION KEY

Purpose: To provide a list of management options for reducing losses caused by insects and diseases in forest stands and to eliminate the need to search through a number of sources for information applicable to various management situations.

Description: The IPM DK (Integrated Pest Management Decision Key) is an interactive, user-friendly, computer program which lists pest management options for controlling

several insect and disease problems affecting southern pines. The program considers such factors as the environment, economics, geographic location, pest interactions, and other variables in listing suggestions for an almost unlimited number of scenarios.

Inputs: Tree species, hazard rating of interest (brown spot, pales weevil, fusiform rust, annosus root rot, littleleaf disease, southern pine beetle).

Accessibility:

1. An Apple II Computer program is available.
2. A User Center is avialable and can be reached by:
   a. Submitting a completed form and receiving back a list of management options.
   b. Calling the Center, giving them your information, and receiving back verbal and/or written recommendations.
   c. Communicating directly, using your terminal, via a telephone hookup.

General Reference: Anderson, R. L.; Belanger, R. P.; Hoffard, W. H.; Mistretta, P.; Uhler, R. J. Integrated pest management decision key; a new decisionmaking tool for the forest manager. *In:* Moser, J. W., Jr., ed. Proceedings of Conference on Microcomputers: A New Tool for Foresters; 1982 May 18 – 20; West Lafayette, IN. SAF 82-05. Washington, DC: Society of American Foresters; 1982. 125 – 130.

Additional Information: Questions regarding this model and its use may be addressed to: IPM-DK User Center, USDA Forest Service, Forest Pest Management, Route 3, Box 1249A, Asheville, NC 28806, Tele: 704/667-5089.

BORAX FOR ANNOSUS PREVENTION

Purpose: To provide an economic assessment for using borax stump treatment while thinning southern pine stands.

Description: This economic analysis of borax treatment for annosus-susceptible stands was developed to provide a basis for assessing the returns with and without the treatment.

Inputs:

1. Species (loblolly, slash, longleaf, or shortleaf)
2. Age of stand (10 – 50 years)
3. Number of stems/acre before thinning (300 – 1500)
4. Site index (6 – 110 feet)
5. Average dbh (5 – 30 inches)
6. Average height (10 – 100 feet)
7. Percentage of stems being thinned (20 – 80)
8. Hourly rate for chainsaw operator ($2 – 10)
9. Cost per 100 lbs. of borax (less than or equal to $50)
10. Age at harvest (20 – 75 years)
11. Pulp or saw harvest (P or S)
12. Current stumpage price ($10 – 300)
13. Marginal tax rate of the decisionmaker (20 – 50 percent)
14. Expected compounded annual inflation rate for the remaining years until rotation (0 – 10 percent)

Accessibility: The program is available on a diskette for the Apple II/e and Apple II look alikes.

Additional Information: Questions regarding this model and its use may be addressed to: Clair H. Redmond, Economist, USDA Forest Service, Forest Pest Management, 1720 Peachtree Rd., NW, Atlanta, GA 30367, Tele: 404/881-2989.

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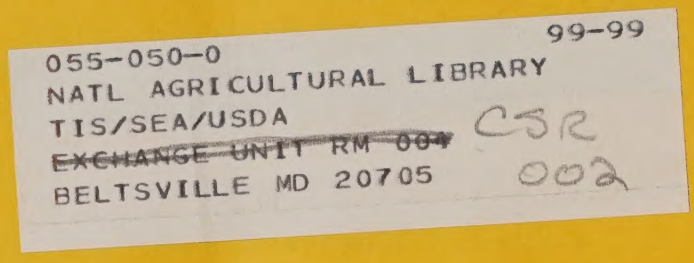

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